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SI/cs 020054WO
09 December 2002

Deep-rolling device of a deep-rolling machine for crankshafts

The invention relates to a deep-rolling device of a deep-rolling machine for crankshafts which is designed in scissor construction and in which two swivellable scissor arms lying opposite each other each carry a deep-rolling roller head or a backing roller head respectively, the backing roller head being fitted with two parallel-axisly arranged backing rollers of which the rotational axes lie in a common plane, with a drive device which generates the closing and opening movement of the deep-rolling device and the deep-rolling force.

Deep-rolling devices of the said type are known from German patent specification DE 197 22 308 C1, the object of which is a deep-rolling machine for crankshafts.

In such a deep-rolling machine, a deep-rolling device is allocated to each main bearing journal and big end bearing journal of a crankshaft.

The design of the known deep-rolling machine is such that when closing each deep-rolling device, first the backing rollers of the backing roller head and then the deep-rolling rollers of the deep-rolling roller head are pressed on one of the main bearing or big end bearing journals of a crankshaft.

The backing roller head and the deep-rolling roller head perform a feed motion and each a swivel motion.

The swivel motion of the backing roller head and deep-rolling roller head in the closing direction carries a risk that a collision can occur between the backing roller head or deep-rolling roller head and the crankshaft in the area of an oil collar as the clearances between the backing roller head and the deep-rolling roller head on the one hand and the two oil collars of a main bearing and big end bearing journal on the other hand are very narrow.

The underlying object of the invention is to structure a deep-rolling device of the type cited initially so that the swivel motion of the backing roller head and deep-rolling roller head in the closing direction cannot trigger a collision with the crankshaft in the area of an oil collar.

According to the invention this object is achieved in that the backing roller head has at least one axial guide which rollers in swivel direction is arranged in front of the backing to close the scissor arm carrying the backing rollers, the longitudinal axis of which guide is perpendicular to the rotational axis of the crankshaft and lies in a direction which encloses an acute angle with the plane of the rotational axes of the backing rollers, and the axial width of which guide is greater than the width of the backing roller head and slightly less than the distance of the oil collars of a main bearing journal or big end bearing journal.

As a result of the invention, on closing the deep-rolling device, before the backing rollers impact against an oil collar, the deep-rolling device is aligned in the axial direction of the crankshaft.

Such an alignment of the deep-rolling device ensures that

the swivel movement of the deep-rolling roller head in the closing direction cannot lead to a collision of the deep-rolling roller head with the crankshaft in the area of an oil collar.

In the case where the acute angle between the longitudinal axis of the axial guide and the common plane formed by the rotational axes of the two backing rollers amounts to 0°, the axial guide has a distance from the common plane. The outer contour of the axial guide can have other forms than well as the classically prismatic or cylindrical form and e.g. be crowned or composed from several geometric shapes.

To machine particularly wide shaft bearing journals, instead of a single guide several axial guides can be provided which are arranged next to each other and fill the gap between two adjacent oil collars. Usually two axial guides are provided, the outer width of which is such that the two axial guides fit in the space between the oil collars with a slight lateral play. Such an arrangement also has the advantage that the axial guides are relatively small. At the same time this reduces the lateral friction between the axial guides and the oil collars.

The invention is now described in more detail below with reference to diagrammatic drawings showing embodiment examples.

- Fig. 1 shows a section through a deep-rolling machine with a part view of a crankshaft transport device, where a deep-rolling device assumes its opening position opposite an introduced crankshaft,
- Fig. 2 shows the cross section through the deep-rolling

machine and a section through a main bearing journal of the crankshaft where the deep-rolling machine is in its closed position,

- Fig. 3 shows a section A of Fig. 2 in enlarged scale,
- Fig. 4 shows a section along line IV - IV in Fig. 3,
- Fig. 5 shows a section analog to Fig. 3 with a special arrangement of the axial guide,
- Fig. 6 shows a first embodiment of an axial guide in longitudinal section,
- Fig. 7 shows a top view onto the embodiment according to Fig. 6,
- Fig. 8 shows a second embodiment of the axial guide in longitudinal section.

A deep-rolling machine 1 is fitted with a drive device (not shown) which serves to hold a crankshaft 3 introduced in the deep-rolling machine 1 with a crankshaft transport device 2.

The drive device generates the rotational movement of the crankshaft 3 about its axis 4 during the deep-rolling of the main bearing journal 5 and big end bearing journal 6. The axis 4 thus lies in the axis of rotation 7 of the drive device.

The present embodiment example is restricted to the deep-rolling of a main bearing journal 5 of the crankshaft 3 as this suffices to explain the subject of the invention.

Allocated to the main bearing journal 5 is a deep-rolling device 8 in scissor construction which is fitted with two scissor arms 9, 10, a scissor rotation point 11, a drive device 12, a deep-rolling roller head 13 and a backing roller head 14. Due to the scissor construction the deep-rolling roller head 13 and the backing roller head 14

cannot be moved individually in the direction along the rotational axis 4. Rather they are arranged and adjustable only in particular planes of the deep-rolling machine 1 corresponding to the respective position of the main bearing journal 5 or big end bearing journal 6 to be machined along the rotational axis 4 of the crankshaft 3. Such a plane is shown for example in Fig. 3 and Fig. 4.

The drive device 12 for the deep-rolling device 8 has an adjustment cylinder 15 and a force device 16.

The adjustment cylinder 15 generates the closing and opening movement of the scissors 9, 10 described above of the deep-rolling device 8; the force device 16 generates the deep-rolling force. Due to the division of the movements generated by cylinders 15 and 16, a particularly narrow construction of the deep-rolling device 8 is achieved.

The deep-rolling device 8 is hinged about a hinge point 17 on an angle lever 19 swivellable about an axis 18.

The angle lever 19 can be swivelled using a piston cylinder unit 20. By actuating the piston cylinder unit 20, the deep-rolling device 8 is brought into and out of the working position i.e. moved in the direction of and opposite to the direction of the axis 4 of the crankshaft 3.

The deep-rolling machine 1 is designed so that on closing the deep-rolling device 8 first the two parallel-axisly arranged backing rollers 21 and 22 of the backing roller head 14 and then the two deep-rolling rollers 23 and 24 of the deep-rolling roller head 13 come to rest on the main bearing journal 5.

Here in the view in Fig. 1 the backing roller head 14 executes a swivel movement 35 counterclockwise and the deep-rolling roller head 13 a swivel movement 36 clockwise about the scissor rotation point 11. The two swivel movements 35 and 36 are performed simultaneously under movement of point 17 in the direction of axis 4 and at their end the closed position is achieved as shown in Fig. 2. The closed position corresponds to the working position of the deep-rolling device 8.

In the swivel movements 35 and 36 of the backing roller head 14 and deep-rolling roller head 13 in the closing direction, a collision with one of the two oil collars 25 or 26 of the main bearing journal 5 is avoided by an axial guide 27. The axial guide 27 is arranged at an acute angle 37 between 0 and 45° to the plane 34 which contains the two rotational axes 32 and 33 of the two backing rollers 21 and 22. The longitudinal axis 41 of the axial guide 27 stands vertical to the rotational axis 4 of the crankshaft 3 (Fig. 5).

The direction 38 of the longitudinal axis 41 of the axial guide 27 - geometrically viewed - encloses the rotational axis 4 of the crankshaft 3 i.e. the longitudinal axis 41 can swing about the rotational axis 4. Comparison of Figs 3 and 5 clearly shows this possibility. For example in the view in Fig. 3 the direction 38 falls in the section plane IV - IV, i.e. the acute angle 37 is 0° and the axial guide 27 has a lateral distance s from the plane 34 containing the two rotational axes 32 and 33. In this special case the plane 34 and the direction 38 run parallel with each other.

In Fig. 5 in contrast the axial guide 27 in relation to the

common plane 34 of the two rotational axes 32 and 33 of the backing rollers 21 and 22 lies at an acute angle 37 which is greater than 0°. This structure means that on swivelling of the backing roller head 14 into the closed position in the direction of the swivel movement 35, the axial guide 27 precedes the two backing rollers 21 and 22. Thus the axial guide 27 precedes the backing rollers 21 and 22 on entering the space defined by the distance 29a of the two oil collars 25 and 26 on the main bearing journal 5. This prevents one of the backing rollers 21 or 22 hitting against one of the oil collars 25 or 26 when the deep-rolling device 8 is closed.

The axial guide 27 can take different forms. In Fig. 3 for example it has a cylindrical form. In Fig. 5 the axial guide 27 has a multiple contour composed of a prismatic body 39 with chamfered edges 40. The axial guide 27 is attached to the backing roller head 14 by a socket screw 42. In the case of bearing journals 5 which have a particularly large width 29a, instead of a single axial guide 27 two axial guides (not shown) can be arranged next to each other where the one lies at the oil collar 25 and the other at the oil collar 26.

Instead of the prismatic body 39 the axial guide 27 can be fitted with lateral sliding bodies 43 which are screwed via countersunk bolts 44 to the body of the axial guide 27. The sliding bodies 43 can for example comprise non-ferrous metal, Teflon, hardened or coated steel, which have particularly good sliding properties.

Because of the scissor construction of the deep-rolling device 8, the axial guide 27 at the same time guides the deep-rolling roller head 13 in the axial direction of the

crankshaft 3.

The width 28 of the axial guide 27 is greater than the width 29 of the backing roller head 14 and slightly smaller than the distance 29a of the oil collars 25, 26 of the main bearing journal 5.

In the closed position of the deep-rolling device 8 (Fig. 2), for the two spaces 30, 31 around 0.25 mm play on each side is provided between the oil collars 25, 26 and the axial guide 27.

Reference list

1	Deep-rolling machine
2	Crankshaft transport device
3	Crankshaft
4	(Rotational) axis of the crankshaft
5	Main bearing journal
6	Big end bearing journal
7	Rotational axis of drive device
8	Deep-rolling machine
9	Scissor arm
10	Scissor arm
11	Scissor rotational point
12	Drive device
13	Deep-rolling roller head
14	Backing roller head
15	Adjustment cylinder
16	Force device
17	Hinge point
18	Axis
19	Angle lever
20	Piston cylinder unit
21	Backing roller
22	Backing roller
23	Deep-rolling roller
24	Deep-rolling roller
25	Oil collar
26	Oil collar
27	Axial guide
28	Axial guide diameter
29	Width of backing roller head
29a	Distance of oil collars
30	Space
31	Space
32	Backing roller axis

33 Backing roller axis

34 Plane through axes 32 and 33

35 Counterclockwise swivel movement

36 Clockwise swivel movement

37 Acute angle

38 Direction

39 Prismatic body

40 Chamfered edge

41 Longitudinal axis

42 Socket screw

43 Lateral sliding body

44 Countersunk bolt

s Lateral spacing